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REPORT ON THE EFFECTS OF NEW DEVELOPMENT AND INFILLING ON THE BURLINGTON WATER PURIFICATION PLANT EXPANSIONS AND WATER DISTRIBUTION SYSTEM

MAY 1981

Simcoe Engineering Limited • Consulting Engineers

DB-063-49

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Mr. H. H. Cripps, P. Eng.
Manager, Planning & Development,
Regional Municipality of Halton,
1151 Bronte Road,
P.O. Box 7000,
Oakville, Ontario.
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Dear Sir:

Re: Report on the Effects of New Development and Infilling on the Burlington Water Purification Plant Expansions and Water Distribution System - Your File DB 063

We submit herewith our report on the effects of new development and infilling on the Burlington Water Purification Plant and Distribution System. In general, as discussed with you and your staff, the ability to pre-determine specific levels of protection capabilities for the remainder of the work required at the plant is very difficult. It is our opinion that the existing chemical facilities and standby power facilities are inadequate and should be upgraded in order to ensure that the plant will perform satisfactorily in all instances. Several other minor components were planned for improvement in the final stage of the water purification plant construction programme.

We must stress, however, that it is very difficult to indicate how these components will effect the overall production capabilities of the facility. The addition of population and other forms of development that require additional production from the existing facilities will only worsen the degree of risk taken with respect to the particular component now considered to be inadequate.

With respect to the water distribution system, we have examined by individual pressure zone, the five year and ultimate requirements for pumping stations, storage and major distribution mains. In Section 3 we have summarized the requirements by zone for the next five-year period. Future works have been listed. However, we have been unable to indicate any timing with respect to these works.

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81 05 08
Mr. H. H. Cripps, P. Eng.
Regional Municipality of Halton

Approximately $3 million will be required for the completion of the water purification plant. In the next five-year period, an amount of $5,780,000 will be required for proposed work in the water distribution system. At this stage it would appear that all of these works would be applicable for a 15 per cent provincial subsidy. Applications for most of these funds have already been made.

Once you and your staff have had an opportunity to review this report, we will be pleased to meet and discuss it with you.

Yours very truly,
SIMCOE ENGINEERING LIMITED

R. L. Smith, P. Eng.

A. J. Bowers, P. Eng.

REPORT ON THE EFFECTS OF NEW DEVELOPMENT AND INFILLING ON THE BURLINGTON WATER PURIFICATION PLANT EXPANSIONS AND WATER DISTRIBUTION SYSTEM

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REPORT SUMMARY

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History of System Development

Reports have been prepared on the water purification plant and the water distribution system in 1976 and 1977 respectively. Based on these reports, certain staged works have been undertaken both at the water plant and in the water distribution system. This report reviews the work undertaken and in hand, and current growth projections to determine what additional works are needed in the short term and the long term for both the water purification plant and the water distribution system.

Projected Water Requirements

Based on information supplied by the Regional Planning Department, we have summarized in Table 1 the estimated population, and industrial and commercial hectarage for the next five years and the ultimate conditions for each of the pressure zones in the Burlington distribution system.

Based on this information, we have calculated projected water production requirements, both by Zone and for the total system as summarized in Table 3. It is estimated that the water purification plant must be capable of supplying 136,500 m^3/d (30 mgd) by the year 1985 and 246,000 m^3/d (54 mgd) for the ultimate development.

Water Distribution System

Based on the production requirements as summarized in Table 3, we have examined each pressure zone in the water distribution system and determined what we would consider to be the necessary additional works for the distribution system in the next five year period and for

the ultimate condition. We have provided this information, separately for each pressure zone, and in each pressure zone we have considered pumping stations, reservoirs and trunk watermains. Tables 6 and 7 summarize the necessary required improvements to the year 1985 and the ultimate system respectively. No timing has been established for the works required beyond the year 1985.

Water Purification Plant

In Section 4 of the report we have examined in detail the various components of the existing water purification plant.

Since 1976, a programme for both remedial work and new construction has been underway at the Burlington plant to ensure continued safe and secure operation and to meet the projected increases in water demand. This programme has generally been implemented as described in the April, 1976 report entitled "Report on Proposed Water Purification Plant Expansion for the City of Burlington" prepared by Simcoe Engineering Limited in association with L. H. Schwindt & Company Limited. Contracts have been let to improve on-site piping filtration and pumping capacity, remedy defects in filters, secure power systems and improve control and operation of the plant. At present there are two contracts in effect, one with Promac Controls Inc. to provide a computer based supervisory control system for the plant and distribution system which will be completed late in 1982. The other contract with Pigott Construction Limited is to provide a high lift pumping station and on-site remedial work and improvements to filters which will be completed in mid 1982.

Yet to be constructed in the proposed expansion programme are a new chemical building, administration facility and other works, including standby power for the low lift pumping station, a new raw water screen, and landscaping, etc. The estimated costs for this final contract not yet tendered is approximately $2.89 million. The vast majority of this cost is related to the new chemical building.

It is our opinion that none of the existing chemical systems are adequate in terms of size of storage, ease of operation, instrumentation, etc. Because of the make-shift nature of some of these installations, good design practices for safe working conditions beyond the legal minima could not be achieved. Much of the equipment is old and the facilities are so widely dispersed throughout the plant, that continued secure operations cannot be guaranteed with the present staff.

With regard to the other major components of the water plant, in Table 8 we have summarized the existing capacity of these facilities. It would be our opinion, assuming that the chemical building and other related facilities not yet in place were constructed, that the water purification plant would be adequate to well beyond the year 1985 and almost for the ultimate requirement which is estimated to be 246,000 m^3/d (54 mgd).

In summary, it is our opinion that some components of the plant, specifically, the chemical system, standby power and administration facilities are inadequate and/or below design standards that could normally be expected of a plant of this size and complexity. Continued increases in production requirements can only result in additional potential problems with respect to security and availability of supply with existing facilities. Operating problems or failures could result in necessary short or long term shutdowns of the treatment facility which would affect, not only any new development, but also existing development in the area serviced by the plant.

TABLE 1

CITY OF BURLINGTON

POPULATION AND LAND USE PREDICTIONS
BY PRESSURE DISTRICT

PRESSURE ZONE	LAND USE	YEAR						ULTIMATE
		1980	1981	1982	1983	1984	1985	
I	Population	67,875	68,377	69,861	71,023	72,657	74,189	94,175
	Industrial & Commercial ha.	209.2	219.4	229.7	239.9	250.2	260.4	360.7
IA	Population	8,257	8,340	8,560	8,795	8,950	9,022	9,685
	Industrial & Commercial ha.	121.2	126.8	132.4	138.0	143.7	149.3	237.1
II	Population	15,090	15,231	15,413	15,927	16,258	16,421	24,820
	Industrial & Commercial ha.	626.3	657.7	689.1	720.4	751.8	783.2	1348.9
III	Population	8,419	8,670	9,677	10,699	11,581	12,341	83,770
	Industrial & Commercial ha.	11.2	11.5	11.8	12.1	12.4	12.7	12.7
IV	Population	8,005	8,556	9,164	9,791	10,452	11,079	13,855
	Industrial & Commercial ha.	-	-	-	-	-	-	-
V	Population	224	224	224	224	224	224	225
	Industrial & Commercial ha.	-	-	-	-	-	-	-
RURAL	Population	4,852	4,852	4,871	4,871	4,871	4,890	6,305
	Industrial & Commercial ha.	2.3	2.3	2.3	2.3	2.3	2.3	2.3
TOTAL*	Population	107,870	109,398	112,899	116,459	120,122	123,276	226,530
	Industrial & Commercial ha.	967.9	1015.4	1063.0	1110.4	1158.1	1205.6	2161.9

* Does not include rural areas.

TABLE 3
PROJECTION PRODUCTION
REQUIREMENTS BY
PRESSURE ZONE

PRESSURE ZONE	YEAR	AVERAGE DAY $m^3/day \times 10^3$	MAXIMUM DAY $m^3/day \times 10^3$	MAXIMUM HOUR A.M. $m^3/day \times 10^3$	MAXIMUM HOUR P.M. $m^3/day \times 10^3$	MINIMUM HOUR $m^3/day \times 10^3$	FIRE FLOW RATE L/s	FIRE FLOW DURATION Hours	FIRE FLOW VOLUME $m^3 \times 10^3$
I	1980	23.03	51.19	40.55	113.31	16.71	287.9	5	5,182
	1981	23.40	52.00	41.63	114.34	16.97	287.9	5	5.182
	1982	24.03	53.40	43.03	116.95	17.42	287.9	5	5.182
	1983	24.57	54.61	44.32	119.03	17.80	287.9	5	5.182
	1984	25.25	56.10	45.77	121.88	18.28	287.9	5	5.182
	1985	25.89	57.53	47.18	124.56	18.74	287.9	5	5.182
	Ultimate	33.54	74.54	62.60	158.80	24.25			
IA	1980	5.97	13.28	15.82	18.21	5.74	234.9	4	3.383
	1981	6.11	13.61	16.35	18.47	5.84	234.9	4	3.383
WATERDOWN	1982	6.30	14.03	16.93	18.95	5.97	234.9	4	3.383
INCLUDED	1983	6.49	14.45	17.51	19.45	6.10	234.9	4	3.383
	1984	6.66	14.83	18.07	19.83	6.22	234.9	4	3.383
	1985	6.81	15.15	18.60	20.07	6.32	234.9	4	3.383
	Ultimate	8.95	19.94	26.71	23.10	7.76			
II	1980	18.17	40.37	61.20	38.24	12.41	265.2	4	3.819
	1981	18.91	42.02	64.07	39.17	12.91	265.2	4	3.819
	1982	19.67	43.70	66.95	40.17	13.42	265.2	4	3.819
	1983	20.51	45.58	69.93	41.69	13.99	265.2	4	3.819
	1984	21.31	47.35	72.86	42.93	14.53	265.2	4	3.819
	1985	22.06	49.01	74.44	43.90	15.03	265.2	4	3.819
	Ultimate	41.61	92.46	147.57	74.62	28.24			
III	1980	2.53	5.61	3.70	13.72	1.85	265.2	4	3.819
	1981	2.60	5.78	3.81	14.13	1.91	265.2	4	3.819
	1982	2.88	6.40	4.16	15.75	2.11	265.2	4	3.819
	1983	3.16	7.02	4.51	17.39	2.32	265.2	4	3.819
	1984	3.41	7.57	4.82	18.81	2.50	265.2	4	3.819
	1985	3.62	8.04	5.09	20.03	2.66	265.2	4	3.819
	Ultimate	22.90	50.90	27.95	134.32	16.94			

TABLE 3

Projection Production Requirements cont'd

PRESSURE ZONE	YEAR	AVERAGE DAY m^3/day x 10^3	MAXIMUM DAY m^3/day x 10^3	MAXIMUM HOUR A.M. m^3/day x 10^3	MAXIMUM HOUR P.M. m^3/day x 10^3	MINIMUM HOUR m^3/day x 10^3	RATE L/s	DURATION Hours	VOLUME m^3 x 10^3
IV	1980	2.16	4.80	2.56	12.81	1.60	151.5	2	1.091
	1981	2.31	5.13	2.74	13.69	1.71	151.5	2	1.091
	1982	2.47	5.50	2.93	14.66	1.83	151.5	2	1.091
	1983	2.64	5.87	3.13	15.67	1.96	151.5	2	1.091
	1984	2.82	6.27	3.34	16.72	2.09	151.5	2	1.091
	1985	2.99	6.65	3.55	17.73	2.22	151.5	2	1.091
	Ultimate	3.74	8.31	4.43	22.17	2.77			
V	1980	.06	.13	.07	.36	.04	45.46	2	.327
	1981	.06	.13	.07	.36	.04	45.46	2	.327
	1982	.06	.13	.07	.36	.04	45.46	2	.327
	1983	.06	.13	.07	.36	.04	45.46	2	.327
	1984	.06	.13	.07	.36	.04	45.46	2	.327
	1985	.06	.14	.07	.36	.05	45.46	2	.327
	Ultimate	.06	.14	.07	.36	.05			
TOTAL	1980	51.91	115.39	123.9	196.65	38.37			
	1981	53.40	118.68	128.67	200.16	39.39			
	1982	55.41	123.16	134.07	206.82	40.80			
	1983	57.44	127.11	139.49	213.59	42.22			
	1984	59.50	132.25	144.94	220.52	43.67			
	1985	61.42	136.52	150.23	226.67	45.02			
	Ultimate	110.81	246.29	269.33	413.37	80.01			

TABLE 6

SUMMARY OF REQUIRED IMPROVEMENTS TO 1985

ZONE I		
1.	Connection to Kingsway Pumping Station	$ 595,000
2.	East Burlington Connection	935,000
ZONE IA		
	Expansion of Waterdown Road Reservoir - 4000 m^3 in 1985	400,000
ZONE II		
	Improvements to Washburn Zone II Pumping Station - add one pump (41,000 m^3/d) and standby in 1982	250,000
ZONE III		
1.	Improvements to Washburn Zone III Pumping Station - add one pump (22,500 m^3/d) and standby in 1982	200,000
2.	500 mm watermain from Washburn to Upper Middle Road - 1982	350,000
3.	Headon Reservoir - 1985 - 16,450 m^3	1,750,000
4.	Feedermain to Headon Reservoir - 1985	1,300,000
	TOTAL	$5,780,000

TABLE 7

SUMMARY OF MAJOR REQUIRED WORKS
BEYOND THE YEAR 1985

DESCRIPTION	ESTIMATED AMOUNT
ZONE I	
1. Addition to Washburn Reservoir	$1,000,000
2. New feedermain to Washburn Pumping Station	900,000
ZONE II	
1. Addition of 2 - 27,000 m^3/d pumping units in Washburn Pumping Station	250,000
2. New 16,000 m^3 (4.0 mg) Zone II Reservoir on Appleby Line	1,600,000
3. New feedermain to proposed Zone II Reservoir	1,250,000
ZONE III	
New Zone III station at new Zone II Reservoir to supply eastern part of Zone III Firm capacity 20,000 m^3/d (4.4 mgd)	500,000
ZONE IV	
New 4500 m^3/d (1 mgd) pump in Bailie Pumping Station	50,000

Note: Other major trunk watermains to be constructed as required by development.

TABLE 8

BURLINGTON TREATMENT PLANT

CAPACITY SUMMARY

Intakes	156,800 m^3/d in winter	34.5 mgd
	256,800 m^3/d in summer	56.5 mgd
Screen	182,000 m^3/d	40.0 mgd
Raw Water Pumping	190,000 m^3/d	41.7 mgd
Flocculation	218,000 m^3/d	48.0 mgd
Filtration #1	164,000 m^3/d	36.0 mgd
Filtration #2	51,000 m^3/d	11.2 mgd
High Lift Pumping	250,000 m^3/d	55.0 mgd

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APPENDIX A - CITY OF BURLINGTON WATER DISTRIBUTION STUDY
- Proposed Design Criteria for Analysis

APPENDIX B - Letter to Mr. R. W. J. Moore dated 79 02 26
- re Deferral of Capital Expdenditures

TABLES

1	Population and Land Use Predictions - By Pressure District	opposite Page 2.1
2	Unit Production Rates Used for Projection of Water Production Requirements	opposite Page 2.2
3	Projection Production Requirements by Pressure Zone	following Page 3.7
4	Projected Pumping Station Requirements	following Page 3.7
5	Projected Reservoir Requirements	following Page 3.7
6	Summary of Required Improvements to 1985	following Page 3.7
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8	Burlington Treatment Plant-Capacity Summary	opposite Page 4.12

SECTION 1

HISTORY OF SYSTEM DEVELOPMENT

SECTION 1

HISTORY OF SYSTEM DEVELOPMENT

In April of 1976, a report was prepared entitled "Report on the Proposed Water Purification Plant Expansions for the City of Burlington" which discussed the overall requirements for uprating and upgrading the existing water purification plant. In that report it was proposed to construct over a period commencing in 1975 and ending in April of 1981, major improvements to all components of the water purifation plant, including screening facilities, low lift facilities, filtration facilities, high lift facilities, administration facilities, and chemical and other associated requirements. Originally it was proposed that the work be undertaken in two major contracts. The first contract to be completed on or about December, 1978. The second contract to be completed on or about May, 1981.

Due to financial restrictions, the proposed expansion programme initially laid out has now been revised in such a manner that three major contracts have been proposed to undertake the work. Specifically, improvements have been made to the low lift pumping station and treatment facilities in the first major contract. The contract just awarded to Pigott Construction will involve the construction of a new high lift pumping station. Still to be undertaken is a contract to construct a new chemical facility, administration facility and other works, including standby power for the low lift pumping station, a new screen, landscaping, etc. The estimated cost for this final contract not yet tendered is approximately $2.89 million.

In conjunction with the report prepared on the water purification plant, a report was completed entitled "Report on the Burlington Water Distribution System" in April of 1977. This report outlined certain deficiencies in the water distribution system. Major improvements have been made to various parts of the water distribution system, including, but not limited to, pumping station, and reservoir expansions and feedermain additions.

This report addresses the effect of additional development on the water distribution system and water purification plant in terms of necessary capital expenditures to meet the required needs.

SECTION 2

PROJECTED PLANT AND SYSTEM PRODUCTION REQUIREMENTS

TABLE 1

CITY OF BURLINGTON

POPULATION AND LAND USE PREDICTIONS

BY PRESSURE DISTRICT

PRESSURE ZONE	LAND USE	YEAR						ULTIMATE
		1980	1981	1982	1983	1984	1985	
I	Population	67,875	68,377	69,861	71,023	72,657	74,189	94,175
	Industrial & Commercial ha.	209.2	219.4	229.7	239.9	250.2	260.4	360.7
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	Industrial & Commercial ha.	626.3	657.7	689.1	720.4	751.8	783.2	1348.9
III	Population	8,419	8,670	9,677	10,699	11,581	12,341	83,770
	Industrial & Commercial ha.	11.2	11.5	11.8	12.1	12.4	12.7	12.7
IV	Population	8,005	8,556	9,164	9,791	10,452	11,079	13,855
	Industrial & Commercial ha.	-	-	-	-	-	-	-
V	Population	224	224	224	224	224	224	225
	Industrial & Commercial ha.	-	-	-	-	-	-	-
RURAL	Population	4,852	4,852	4,871	4,871	4,871	4,890	6,305
	Industrial & Commercial ha.	2.3	2.3	2.3	2.3	2.3	2.3	2.3
TOTAL*	Population	107,870	109,398	112,899	116,459	120,122	123,276	226,530
	Industrial & Commercial ha.	967.9	1015.4	1063.0	1110.4	1158.1	1205.6	2161.9

* Does not include rural areas.

SECTION 2

PROJECTED PLANT AND SYSTEM PRODUCTION REQUIREMENTS

General

In order to determine the production requirements for the short term and long term needs of the water supply system, it was necessary to review with the Regional Planning Department, expected population, industrial and commercial development. A summary of the information received from the Planning Department is attached hereto in Table 1. This table summarizes, in general, the projected five-year growth and ultimate growth for residential development, as well as industrial and commercial development.

It is estimated that the serviced population will increase from the present amount of 107,870 to 123,276 by the year 1985. The ultimate serviced population is estimated to be 226,530. Industrial and commercial development is expected to increase from approximately 970 hectares to 1200 hectares by the year 1985, with an ultimate development of 2160 hectares.

Of these amounts, approximately 1140 persons in Zone I are in Southwest Oakville and approximately 200 hectares of industrial land in Southwest Oakville are included in Zone II Ultimate.

Projected Water Production Rates

We have reviewed the projected water production rates experienced for 1979 and 1980 at the water purification plant and have revised our previous unit rates for projected water production requirements for the water plant and system, as summarized in Table 2.

Water Plant and System Production Requirements

On Table 1 enclosed herewith, we have calculated the anticipated contributory population and industrial and commercial land use by zone and

TABLE 2

UNIT PRODUCTION RATES

USED FOR PROJECTION OF WATER PRODUCTION REQUIREMENTS

	RESIDENTIAL		COMMERCIAL & INDUSTRIAL	
	gpcd	Lpcd	gpad	$m^3/ha.d$
Average Day	59.4	270	2,005	22.5
Maximum Day	132.0	600	4,455	50.0
Maximum Hour AM	70.4	320	8,019	90.0
Maximum Hour PM	352.0	1,600	2,005	22.5
Minimum Hour	44.0	200	1,337	15.0

the requirements for the water purification plant. This information has been supplied for the individual years 1980 through 1985 and the ultimate system. Based on the unit production rates, as summarized in Table 2, we have calculated projected production requirements by pressure district and the total production requirements for the water purification plant. Specifically relating to the water purification plant, it is necessary to supply the maximum day rate. For the year 1985, we have calculated a maximum day rate of 136,500 m^3/d (30 mgd). The ultimate water purification plant capacity, based on the information supplied, should be 246,000 m^3/d (54 mgd).

An additional amount equal to 2270 m^3/d (0.5 mgd) for maximum day has been added to the Zone IA production and water plant production requirements. This amount has been added based on an agreement between the Regional Municipalities of Halton and Hamilton Wentworth which allows for the sale of 2270 m^3/d of water to the former Village of Waterdown.

In Section 3 of this report we have summarized the necessary requirements for the water distribution system based on the updated information obtained for this report. In Section 4 we have discussed the requirements at the water purification plant for the same periods.

SECTION 3

WATER DISTRIBUTION SYSTEM REQUIREMENTS

SECTION 3

WATER DISTRIBUTION SYSTEM REQUIREMENTS

General

In this section of the report, we have briefly outlined water system requirements for the existing 1985 and ultimate conditions based on the production requirements as outlined in Table 3 of this report. Investigations have been made with respect to the water pumping stations, reservoirs and trunk watermains in this section of the report.

In the attached pocket hereto, we have enclosed herewith a copy of our updated plan entitled "City of Burlington: Proposed Water Distribution System Improvements" dated January, 1977 for reference purposes. Water pumping station, storage and distribution requirements were developed for each of the major zones based on the criteria as summarized herewith in Appendix A. Table 4 attached hereto summarizes pumping station requirements and Table 5 summarizes water storage requirements by pressure zone within the system.

ZONE I SYSTEM

Pumping Stations

The Zone I system is supplied directly from the water purification plant and, therefore, the high lift pumping station must be capable of supplying the Zone 1 system, as well as the other pressure zones within the City of Burlington Water System. With regard to pumping capabilities within the Zone I system, the proposed expanded high lift, which is now under construction, will have a firm capacity of at least 250,000 m^3/d (55 mgd). Based on this pumping capability, the existing water purification plant and the high lift pumping station, is capable of supplying the entire water system to beyond the year 1985.* Reference is made to a letter dated 79 02 26, entitled "Burlington Water Supply System - Deferral of Capital Expenditures", a

*Following completion of construction of the new high lift pumping station which is estimated to occur in 1982.

copy of which is attached hereto as Appendix B. At that time, a decision was made to defer certain reservoir expansions, since available high lift pumping capacity and production capabilities would allow a deferral of balancing storage within certain reservoirs of the system. We have taken this into account in this report for various components of the system.

Reservoirs

The existing reservoirs on the Zone I system include the Brant Street and Washburn Reservoirs which have a total combined capacity of 25,000 m^3 (5.5 mg). Based on our analysis as summarized in Table 5 attached, this would be adequate, based on maximum day production rates to the year 1985. Assuming a portion of the balancing storage for Zone I could be supplied directly from the plant, the proposed Zone I reservoir expansion would be necessary somewhere beyond the year 1985.

Watermains

It is estimated that only two additional major watermains in the Zone I distribution system will be required by the year 1985. These include:

A connection to the Kingsway Pumping Station, from the extension of the existing 600 mm (25 inch) watermain. Necessary sizing is estimated for this location to be as follows:

•525 m of 600 mm - Estimated Cost	$ 220,000
•930 m of 500 mm - Estimated Cost	375,000
TOTAL	$ 595,000

In the extreme east, a proposed watermain extension will be required, generally along the HEPC right-of-way in the north of Zone I and southerly along the extension of Burloak Drive, in order to service the lands not developed in this area, as well as some residential areas in Oakville. This watermain will also strengthen the existing system in the eastern extremity of Burlington. The

estimated cost of this watermain would be as follows:

•2000 m of 500 mm - Estimated Cost	$ 665,000
•1000 m of 400 mm - Estimated Cost	270,000
TOTAL	$ 935,000

ZONE IA SYSTEM

The Zone IA system is supplied via the Kingsway Pumping Station which boosts the pressure from the Zone I system into the Aldershot area. Floating storage is provided by the Waterdown Road Reservoir and, in addition to supplying the Zone IA area, the Zone IA system must supply an average maximum day rate of 2270 m^3/d (.5 mgd) to the former Village of Waterdown.

Pumping Station

The existing pumping station at Kingsway has a firm capacity of 26,000 m^3/d (5.75 mgd). This will allow pumping at a greater than the maximum day rate from this station for an extended period of time. At present, a standby diesel generator is being installed in this station and when this work is completed, it is not anticipated that any future additions will be required at this station.

Reservoir

Based on reservoir requirements, the existing 7300 m^3 (1.6 mg) Waterdown Road reservoir should have a volume of approximately 8400 m^3 (1.85 mg). Additional capacity of approximately 3000 m^3/d (.70 mgd) will be required for the ultimate condition. It is our recommendation at this time that this reservoir should be expanded by approximately 4000 to 5000 m^3 on or about the year 1985. It is estimated that the cost of this expansion will be approximately $400,000.

Watermains

All of the critical watermain trunks in this area have been, or are under construction at the present time. Some additional watermains, as proposed in the original distribution report will be required

as development proceeds, particularly in the area south of Hwy. 403 between King Road and Waterdown Road.

ZONE II SYSTEM

The Zone II system is supplied via the Washburn Pumping Station which pumps directly to the Zone II system. Floating ground storage for the Zone II system is supplied by the Bailie Reservoir. The Zone II section of the Washburn Station also supplies water for the Bailie Pumping Station which repumps to Zone IV. Of less importance to the Zone II system is the Mount Forest Pumping Station, which for the purposes of this report has been rated at a firm capacity of 4400 m^3/d.

Pumping Stations

The present firm capacity of the Zone II section of the Washburn Pumping Station is approximately 41,000 m^3/d (9 mgd). Additional capacity will be required at this station within the next two or three years. Arrangements have already been made in this station for additional pumping units. We would recommend the installation of at least one new 27,000 m^3/d (6 mgd) unit in the Zone II section in order that it will be capable of supplying maximum hour rates directly to the system. The estimated cost, including associated transformers and auxiliary equipment is $150,000. In addition to the proposed new pumping unit in this station, we have made recommendations for the installation of standby power for this station. The standby power in this station would supply both the Zone II and Zone III pumping units. It is estimated at this time that the costs of standby power could be of the order of $200,000 for both Zones.

Storage

As summarized in Table 5, Necessary Storage Requirements, additional capacity will be required for the Zone II system at some time in the future. It was proposed in our original report on the storage capabilities that a second reservoir will ultimately be supplied in the Zone II system. It is our opinion that this reservoir should be in the vicinity of the extension of Appleby Line, north of Dundas Street.

We would recommend that every attempt be made to offset the construction of this reservoir as long as feasible. The need for this reservoir will not only be dependent on development in the eastern part of Zone II, but will also be dependent on development in the eastern part of Zone III.

Watermains

Additional watermains may be required in the Zone II east of Walker's Line. These watermains will be directly dependent on additional industrial development east of this location.

In addition to the Zone II Burlington area, an additional area of approximately 200 hectares in West Oakville will ultimately be serviced by this system. Although definitive sizing has not been considered in this report, it would in all probability be necessary to oversize the watermain on the proposed extension of Mainway between Appleby Line and Burloak Drive. In addition, the proposed 300 mm (12-inch) watermain as previously indicated on Burloak Drive will have to be oversized.

ZONE III SYSTEM

General

The Zone III system at present comprises primarily two major components. The Washburn Pumping Station which supplies the area and the Tyandaga Reservoir which is the necessary floating storage for this Zone.

Pumping Station

We have assumed for this pressure zone that until such time as the proposed Headon Reservoir is in place, that the Washburn Zone III Pumping Station will supply the maximum hour rate. This rate in 1985 would be approximately 22,000 m^3/d (5 mgd). An additional pumping unit should be installed in the Zone III section of the Washburn Station in 1982 or 1983. Although a reservoir deficiency has been identified in

Zone III, the need to correct it will not be imminent until such time as the pumping station can no longer meet the required demand. We would, therefore, recommend that a new 22,500 m^3/d (5 mgd) pump be installed in the Zone III system of this station. The estimated cost for this installation would be approximately $100,000.

Reservoir

Based on the above described approach, the proposed Headon Reservoir and connection from the Headon Reservoir to Upper Middle Road would be required to be in service by the year 1985. The estimated cost for the Headon Reservoir and proposed inter-connection main is as follows:

- Headon Reservoir - 16,450 m^3 (4.0 mg)
  Estimated cost - $ 1,750,000
- Interconnecting main from Headon Reservoir to Upper Middle Road
  900 m of 750 mm - $ 350,000
  1400 m of 500 mm - 450,000
  1400 m of 600 mm - 500,000
  Estimated Cost - $ 1,300,000

Watermains

With respect to the trunk watermain between the Washburn Pumping Station and Upper Middle Road, we would recommend that this watermain be installed as soon as reasonably possible, as this has been identified as a serious bottleneck with respect to supplying the necessary flows to the Zone III system. Estimated costs of this watermain are as follows:

575 m of 600 mm - Estimated Cost $350,000

ZONE IV SYSTEM

The existing Zone IV system is presently nearly all developed. The area is serviced via the Tyandaga Pumping Station and the Bailie Pumping Station, both of which are part of the Zone IV system. The Beaufort Reservoir acts as floating storage for this zone and supplies emergency and balancing storage and fire protection. The Tyandaga Pumping Station is

rated at a firm capacity of 2270 m^3/d (.5 mgd), while the Bailie Pumping Station is rated at 4500 m^3/d (1.0 mgd). Up until the year 1985, no additional pumping capacity will be required in this Zone. It may be necessary after that date to supply an additional pumping unit in the Bailie Pumping Station, for which space has already been supplied. A slight volume deficiency has been identified in the Beaufort Reservoir for the ultimate development. We are, however, of the opinion that this deficiency is not significant enough to warrant major expansions to this particular reservoir. It would be very difficult to make expansions to this reservoir under present circumstances. Unless some additional development occurs, either in Zone IV or the Zone V system, we do not recommend any changes at this time.

ZONE V SYSTEM

The Zone V system is a very small system serving only approximately 250 households. The pumping station has been upgraded in previous years to meet these needs and, as a result, we do not recommend any major improvements to the Zone V system at this time.

Summary and Conclusions

In this section of the report we have attempted to identify all deficiencies in the Burlington Distribution System which we feel will need correction within the next five years. In addition, we have identified or attempted to identify all additional works of major consequence which will be required for the ultimate capacity as outlined in this report. In the following Tables No. 6 and No. 7, we have summarized the respective requirements for the water distribution system.

TABLE 3
PROJECTION PRODUCTION
REQUIREMENTS BY
PRESSURE ZONE

PRESSURE ZONE	YEAR	AVERAGE DAY $m^3/day \times 10^3$	MAXIMUM DAY $m^3/day \times 10^3$	MAXIMUM HOUR A.M. $m^3/day \times 10^3$	MAXIMUM HOUR P.M. $m^3/day \times 10^3$	MINIMUM HOUR $m^3/day \times 10^3$	FIRE FLOW RATE L/s	FIRE FLOW DURATION Hours	FIRE FLOW VOLUME $m^3 \times 10^3$
I	1980	23.03	51.19	40.55	113.31	16.71	287.9	5	5,182
	1981	23.40	52.00	41.63	114.34	16.97	287.9	5	5.182
	1982	24.03	53.40	43.03	116.95	17.42	287.9	5	5.182
	1983	24.57	54.61	44.32	119.03	17.80	287.9	5	5.182
	1984	25.25	56.10	45.77	121.88	18.28	287.9	5	5.182
	1985	25.89	57.53	47.18	124.56	18.74	287.9	5	5.182
	Ultimate	33.54	74.54	62.60	158.80	24.25			
IA	1980	5.97	13.28	15.82	18.21	5.74	234.9	4	3.383
	1981	6.11	13.61	16.35	18.47	5.84	234.9	4	3.383
WATERDOWN	1982	6.30	14.03	16.93	18.95	5.97	234.9	4	3.383
INCLUDED	1983	6.49	14.45	17.51	19.45	6.10	234.9	4	3.383
	1984	6.66	14.83	18.07	19.83	6.22	234.9	4	3.383
	1985	6.81	15.15	18.60	20.07	6.32	234.9	4	3.383
	Ultimate	8.95	19.94	26.71	23.10	7.76			
II	1980	18.17	40.37	61.20	38.24	12.41	265.2	4	3.819
	1981	18.91	42.02	64.07	39.17	12.91	265.2	4	3.819
	1982	19.67	43.70	66.95	40.17	13.42	265.2	4	3.819
	1983	20.51	45.58	69.93	41.69	13.99	265.2	4	3.819
	1984	21.31	47.35	72.86	42.93	14.53	265.2	4	3.819
	1985	22.06	49.01	74.44	43.90	15.03	265.2	4	3.819
	Ultimate	41.61	92.46	147.57	74.62	28.24			
III	1980	2.53	5.61	3.70	13.72	1.85	265.2	4	3.819
	1981	2.60	5.78	3.81	14.13	1.91	265.2	4	3.819
	1982	2.88	6.40	4.16	15.75	2.11	265.2	4	3.819
	1983	3.16	7.02	4.51	17.39	2.32	265.2	4	3.819
	1984	3.41	7.57	4.82	18.81	2.50	265.2	4	3.819
	1985	3.62	8.04	5.09	20.03	2.66	265.2	4	3.819
	Ultimate	22.90	50.90	27.95	134.32	16.94			

TABLE 3

Projection Production Requirements cont'd

PRESSURE ZONE	YEAR	AVERAGE DAY $m^3/day \times 10^3$	MAXIMUM DAY $m^3/day \times 10^3$	MAXIMUM HOUR A.M. $m^3/day \times 10^3$	MAXIMUM HOUR P.M. $m^3/day \times 10^3$	MINIMUM HOUR $m^3/day \times 10^3$	RATE L/s	DURATION Hours	VOLUME $m^3 \times 10^3$
IV	1980	2.16	4.80	2.56	12.81	1.60	151.5	2	1.091
	1981	2.31	5.13	2.74	13.69	1.71	151.5	2	1.091
	1982	2.47	5.50	2.93	14.66	1.83	151.5	2	1.091
	1983	2.64	5.87	3.13	15.67	1.96	151.5	2	1.091
	1984	2.82	6.27	3.34	16.72	2.09	151.5	2	1.091
	1985	2.99	6.65	3.55	17.73	2.22	151.5	2	1.091
	Ultimate	3.74	8.31	4.43	22.17	2.77			
V	1980	.06	.13	.07	.36	.04	45.46	2	.327
	1981	.06	.13	.07	.36	.04	45.46	2	.327
	1982	.06	.13	.07	.36	.04	45.46	2	.327
	1983	.06	.13	.07	.36	.04	45.46	2	.327
	1984	.06	.13	.07	.36	.04	45.46	2	.327
	1985	.06	.14	.07	.36	.05	45.46	2	.327
	Ultimate	.06	.14	.07	.36	.05			
TOTAL	1980	51.91	115.39	123.9	196.65	38.37			
	1981	53.40	118.68	128.67	200.16	39.39			
	1982	55.41	123.16	134.07	206.82	40.80			
	1983	57.44	127.11	139.49	213.59	42.22			
	1984	59.50	132.25	144.94	220.52	43.67			
	1985	61.42	136.52	150.23	226.67	45.02			
	Ultimate	110.81	246.29	269.33	413.37	80.01			

TABLE 4

PROJECTED PUMPING STATION REQUIREMENTS

STATION	AREA SERVED	YEAR	AVERAGE DAY $m^3/day \times 10^3$	MAXIMUM DAY $m^3/day \times 10^3$	MAXIMUM HR. PM $m^3/day \times 10^3$
BEAUFORT	Zone V	1980	.06	.13	.36
		1981	.06	.13	.36
		1982	.06	.13	.36
		1983	.06	.13	.36
		1984	.06	.13	.36
		1985	.06	.14	.36
		Ultimate	.06	.14	.36
TYANDAGA	Part of Zone IV & V	1980	1.01	2.27	2.27
		1981	1.01	2.27	2.27
		1982	1.01	2.27	2.27
		1983	1.01	2.27	2.27
		1984	1.01	2.27	2.27
		1985	1.01	2.27	2.27
		Ultimate	1.01	2.27	2.27
BAILIE	Part of Zone IV & V	1980	1.21	2.66	10.90
		1981	1.36	2.99	11.78
		1982	1.52	3.36	12.75
		1983	1.69	3.73	13.76
		1984	1.87	4.13	14.81
		1985	2.04	4.52	15.82
		Ultimate	2.79	6.18	20.26
WASHBURN II	Part of Zone II and Bailie	1980	17.36	38.49	44.59
		1981	18.25	40.47	46.40
		1982	19.17	45.52	48.37
		1983	20.18	44.77	50.90
		1984	21.16	46.94	53.19
		1985	22.08	48.99	55.17
		Ultimate	50.29	111.26	90.33
WASHBURN III	Zone III and Tyandaga	1980	3.54	7.88	15.99
		1981	3.61	8.05	16.40
		1982	3.89	8.67	18.02
		1983	4.17	9.29	19.66
		1984	4.42	9.84	21.08
		1985	4.63	10.31	22.30
		Ultimate	16.00	36.00	136.59
MOUNT FOREST	Part of Zone II	1980	2.02	4.55	4.55
		1981	2.02	4.55	4.55
		1982	2.02	4.55	4.55
		1983	2.02	4.55	4.55
		1984	2.02	4.55	4.55
		1985	2.02	4.55	4.55
		Ultimate	2.02	4.55	4.55
NEW ZONE III			7.91	17.17	

TABLE 4
Pumping Station Requirements cont'd

STATION	AREA SERVED	YEAR	AVERAGE DAY $m^3/day \times 10^3$	MAXIMUM DAY $m^3/day \times 10^3$	MAXIMUM HR. PM $m^3/day \times 10^3$
WATERDOWN	Waterdown	1980	1.01	2.27	2.27
		1981	1.01	2.27	2.27
		1982	1.01	2.27	2.27
		1983	1.01	2.27	2.27
		1984	1.01	2.27	2.27
		1985	1.01	2.27	2.27
		Ultimate	1.01	2.27	2.27
KINGSWAY	Zone IA & Water-down	1980	5.97	13.28	18.21
		1981	6.11	13.61	18.47
		1982	6.30	14.03	18.95
		1983	6.49	14.45	19.45
		1984	6.66	14.83	19.83
		1985	6.81	15.15	20.07
		Ultimate	8.96	19.94	23.10
WATER TREATMENT PLANT	Zones I, IA, II, III, IV & V & Waterdown	1980	32.18	71.53	122.11
		1981	33.43	74.34	127.41
		1982	34.98	77.80	134.33
		1983	36.63	81.46	141.47
		1984	38.21	84.96	148.30
		1985	39.66	88.19	153.36
		Ultimate	110.81	246.29	413.37

TABLE 5

PROJECTED RESERVOIR REQUIREMENTS

RESERVOIR	AREA SERVED	YEAR	BALANCING m^3	FIRE FLOW m^3	EMERGENCY m^3	TOTAL REQUIRED m^3	EXISTING CAPACITY
BEAUFORT	Zone IV & V	1980	986	1418	1202	3606	3636
		1981	1052	1418	1235	3705	3636
		1982	1126	1418	1272	3816	3636
		1983	1200	1418	1309	3927	3636
		1984	1280	1418	1349	4047	3636
		1985	1358	1418	1388	4164	3636
		Ultimate	1690	1418	1554	4662	3636
TYANDAGA PLUS FUTURE RESERVOIR	Zone III	1980	1122	3819	2470	7411	4545
		1981	1156	3819	2488	7463	4545
		1982	1280	3819	2550	7649	4545
		1983	1404	3819	2611	7834	4545
		1984	1514	3819	2666	7999	4545
		1985	1608	3819	2714	8141	4545
		Ultimate	10180	3819	7000	20999	4545
BAILIE PLUS FUTURE RESERVOIR	Zone II	1980	8074	2819	5946	17839	17545
		1981	8404	3819	6112	18335	17545
		1982	8740	3819	6280	18839	17545
		1983	9116	3819	6468	19803	17545
		1984	9470	3819	6645	19934	17545
		1985	9802	3819	6810	20431	17545
		Ultimate	18492	3819	11156	33467	17545
BRANT STREET & WASHBURN	Zone I	1980	10238	5182	7710	23130	25000
		1981	10400	5182	7791	23373	25000
		1982	10680	5182	7931	23793	25000
		1983	10922	5182	8552	24656	25000
		1984	11220	5182	8201	24603	25000
		1985	11506	5182	8344	25032	25000
		Ultimate	14908	5182	10045	30135	25000
WATERDOWN	Zone IA	1980	2202	3383	2792	8377	7273
		1981	2268	3383	2825	8476	7273
		1982	2352	3383	2867	8602	7273
		1983	2436	3383	2910	8728	7273
		1984	2512	3383	2947	8842	7273
		1985	2576	3383	2980	8938	7273
		Ultimate	3534	3383	3458	10375	7273

TABLE 6

SUMMARY OF REQUIRED IMPROVEMENTS TO 1985

ZONE I		
1.	Connection to Kingsway Pumping Station	$ 595,000
2.	East Burlington Connection	935,000
ZONE IA		
	Expansion of Waterdown Road Reservoir - 4000 m^3 in 1985	400,000
ZONE II		
	Improvements to Washburn Zone II Pumping Station - add one pump (41,000 m^3/d) and standby in 1982	250,000
ZONE III		
1.	Improvements to Washburn Zone III Pumping Station - add one pump (22,500 m^3/d) and standby in 1982	200,000
2.	500 mm watermain from Washburn to Upper Middle Road - 1982	350,000
3.	Headon Reservoir - 1985 - 16,450 m^3	1,750,000
4.	Feedermain to Headon Reservoir - 1985	1,300,000
	TOTAL	$5,780,000

TABLE 7

SUMMARY OF MAJOR REQUIRED WORKS
BEYOND THE YEAR 1985

DESCRIPTION	ESTIMATED AMOUNT
ZONE I	
1. Addition to Washburn Reservoir	$1,000,000
2. New feedermain to Washburn Pumping Station	900,000
ZONE II	
1. Addition of 2 - 27,000 m^3/d pumping units in Washburn Pumping Station	250,000
2. New 16,000 m^3 (4.0 mg) Zone II Reservoir on Appleby Line	1,600,000
3. New feedermain to proposed Zone II Reservoir	1,250,000
ZONE III	
New Zone III station at new Zone II Reservoir to supply eastern part of Zone III Firm capacity 20,000 m^3/d (4.4 mgd)	500,000
ZONE IV	
New 4500 m^3/d (1 mgd) pump in Bailie Pumping Station	50,000

Note: Other major trunk watermains to be constructed as required by development.

SECTION 4

DESCRIPTION AND CAPACITY ANALYSIS OF BURLINGTON WATER TREATMENT PLANT

SECTION 4

DESCRIPTION AND CAPACITY ANALYSIS OF BURLINGTON WATER TREATMENT PLANT

HISTORY OF RECENT IMPROVEMENTS

Since 1976 a programme for both remedial work and new construction has been underway at the Burlington plant to allow continued safe and secure operation and permit expansion to meet projected demands. This programme has generally been implemented as described in the April 1976 report entitled "Report on Proposed Water Purification Plant Expansion for the City of Burlington" prepared by Simcoe Engineering Limited in association with L. H. Schwindt & Co. Ltd.

Various contracts have been let to improve on-site piping, filtration and pumping capacity; remedy defects in filters; secure the power systems; and improve the control and operation of the plant. The most recently completed contract was with Frid Construction Ltd. for $3.4 million for additional filtration capacity.

At present, two contracts are in effect: one with Promac Controls Inc. to provide a computer-based supervisory and control system for the plant and distribution system, which will be complete in late 1982; the other with Pigott Construction Ltd. to provide a new high lift pumping station, on-site piping, remedial work and improvements to filters, which will be complete in mid 1982.

COMPONENT ANALYSIS

This general description and analysis refers to the state of the works expected when current contracts for construction by Pigott Construction Ltd. and Promac Controls Inc. are concluded, some time in late 1982.

1. Intakes

There are four intakes from Lake Ontario to the treatment plant. Two of these have not been in use for many years and can be considered as no longer serviceable. The remaining two intakes are 900 mm (36 inch) diameter

and 1500 mm (60 inch) diameter, extending approximately 730 metres (2400 feet) in the Lake, and at a depth of about 8 metres (25 feet) below mean lake level.

Since flow through an intake is by gravity, the lake level can considerably affect the capacity of an intake to provide water for treatment. The lake level varies seasonally, and also annually on approximately a seven year cycle.

Hydraulic analyses of flow through the intakes under these conditions indicates the intake capacities to be as follows:

900 mm	winter low level	29,500 m^3/d (6.5 mgd)
900 mm	summer low level	50,000 m^3/d (11.0 mgd)
1500 mm	winter low level	127,300 m^3/d (28.0 mgd)
1500 mm	summer low level	206,800 m^3/d (45.5 mgd)
900 + 1500 mm	winter low level	156,800 m^3/d (34.5 mgd)
900 + 1500 mm	summer low level	256,800 m^3/d (56.5 mgd)

Under certain (relatively abnormal) lake conditions it is possible for intakes to be blocked partially or completely by frazil ice formation. Conventional practice is to provide some means of back-flushing the intake to remove this blockage. No such means exists at the plant at present, but suitable piping to permit such remedial action is part of the work proposed to be contracted in future.

2. Screens

There are two screens in the inlet works of the plant to remove fish, debris or other material which might cause damage to the raw water pumps.

One of these screens is a motor driven, moveable, automatically cleaned screen with a capacity to screen 182,000 m^3/d (40 mgd). The other is a fixed, manually cleaned screen with a maximum capacity of 68,000 m^3/d (15 mgd). Because of the inconvenience in cleaning this screen, it is normally not used except in emergency conditions.

Conventional practice in large water treatment plants is to have duplicate facilities of the automatic mechanical type.

3. Raw Water Pumping Station

There are a total of six raw water pumping units, one of which is equipped with a dual diesel-electric drive. The pumps range from 22,300 m^3/d (4.9 mgd) to 90,900 m^3/d (20 mgd) individual capacity. Total installed capacity is 280,000 m^3/d (61.7 mgd) but conventional practice is to quote a "firm" capacity, which assumes the loss of the largest single unit. Under these circumstances the conventional rating of the low lift station is 190,000 m^3/d (41.7 mgd).

Under power failure conditions the pumping capacity (of the diesel-electric unit) is 34,100 m^3/d (7.5 mgd). Conventional practice is to provide either engine driven pumps or standby power to meet average day requirements (as discussed later). No such standby power presently exists, except for plant lighting.

4. Flocculation Tanks

There are three pairs of flocculation tanks with a total capacity of 164,000 m^3/d (36 mgd), which serve filters 8-16. There is allowance for future expansion of these tanks to 218,000 m^3/d (48 mgd).

5. Filtration Building No. 1

There are a total of eight filters, 8-16 (excl. 15) four with 13,600 m^3/d (3 mgd) capacity each, four with 27,300 m^3/d (6 mgd) capacity each, for a total of 164,000 m^3/d (36 mgd) filtration capacity. While it is possible to operate these units at higher throughputs for limited periods of time under advantageous raw water conditions, the design rating of 164,000 m^3/d is based on continuous treatment at average water conditions, and can be considered to be the continuous maximum rate.

Since the filters are non-mechanical in nature and therefore highly reliable, the operating capacity is usually assumed equal to the installed capacity.

The continued use of these filters requires periodic washing to remove the entrained solids captured in the filter media. This is accomplished by upflow washing of the filter beds.

Conventional practice, which has been followed in the design of the filters, is to provide dual washwater pumps of equal capacity, either of which can completely clean one of the smaller filters or partially clean a larger filter, and both of which are used to completely clean one of the large filters.

All instrumentation and control systems in the building are connected to the new supervisory control system. (see item 8)

6. Filtration Building No. 2

There are a total of seven filters, 1-7, three with a capacity of 4,100 m^3/d (0.9 mgd) each and four with a capacity of 12,700 m^3/d (2.8 mgd) each, for a total of 51,000 m^3/d (11.2 mgd).

Controls and instrumentation for these filters are of a much lesser standard then for filtration building no. 1. The mechanical equipment, i.e. piping and valves, is in need of repair/maintenance, and is of a much lesser standard then filtration building no. 2.

These filters are backwashed directly from a high pressure main via a pressure reducing and flow control valve. This practice is not usual for filters permanently in service, but in view of the reduced need for filters 1-7 to be used, except in emergency, this method of providing backwash is economically justified since it is substantially cheaper than the provision of dual washwater pumps.

Because of the greater ease of operation of individual filters, and the fact that demands up to 164,000 m^3/d can be met totally from filtration building no. 1, it is likely that these filters will be taken out of service, until the projected water demand exceeds the capacity of Filtration Building no. 1.

Controls and instrumentation in building no. 2 are not connected to the central control system for the plant.

7. New High Lift Pumping Station

In the new high lift pumping station now under construction, there will be a total of six finished water pumping units, one of which is equipped with a dual diesel-electric drive; a second pump is arranged to receive a diesel drive in future. The pumps range from 32,700 m^3/d (7.2 mgd) to 91,000 m^3/d (20 mgd) individual capacity. Total installed capacity is 341,000 m^3/d (75 mgd) with a firm capacity (as defined in Section 3) of 250,000 m^3/d (55 mgd).

Under power failure conditions, conventional practice is to provide standby power to meet average day requirements, which is the case for this station, using the diesel engine driven pump to produce about 110,000 m^3/d (24 mgd) at the average day pressure.

8. Control Systems

With the exception of chemical systems (Section 9), and filtration building no. 2 (section 6), all controls and instrumentation are included in the computer-based supervisory and control system.

This system allows for the following control options:-

- at each piece of equipment, manual operation;
- from local control stations adjacent to each piece of equipment;
- from main control stations in each building (i.e. filtration building, pumping station);
- from main control room manually through the computer;
- from main control room automatically.

Dual computers, one on standby, are used and the computer system is connected to an uninterruptible power supply with a one-hour reserve capacity.

The control system is fully secure.

9. Chemical Systems

The present chemical systems are:

A. Sodium Hypochlorite used for disinfection of the raw water direct injection into the raw water pumping station well. This is an essential system.

B. Aluminum Sulphate used for coagulating suspended matter in the raw water by direct injection into the raw water pumping station well. This is an essential system.

C. Polyelectrolyte used to assist coagulation of suspended matter in the raw water by direct injection into the raw water pumping station well. While not an essential system, this is most useful in improving water quality.

D. Sodium Chlorite used to produce chlorine dioxide for filtered water disinfection and control of phenol based odours. This is added to the high lift station suction piping. This is a non-essential system in terms of water quality from the point of view of safety.

E. Hydrofluosilicic Acid used to fluoridate the finished water by direct injection into the high pressure discharge mains. This is a non-essential system.

F. Chlorine Gas used for final disinfection of the filtered water. This is added by direct injection into the high lift station suction piping. This is an essential system.

It is difficult to place a firm capacity to a chemical system, since it comprises usually only two elements - storage and rate of application capacity. While storage capacity is fixed, an increase in the frequency of chemical deliveries can effectively increase the 'capacity' of the system. Chemical feed pumps are relatively inexpensive and easy to replace with models of higher capacity, and therefore are not a limiting constraint on capacity.

Conventional practice is to provide sufficient storage for a thirty day supply to provide a safe margin against delays in delivery caused by inclement weather, supplier or carrier strikes, etc.

Metering or feed pumps are normally provided which can pump the anticipated peak plant throughput demand for the chemicals, and one standby unit for each chemical system is provided.

For simplicity of maintenance, supervision, chemical deliveries, and special ventilation and personnel protection systems, good practice is to locate all chemical systems together.

A. Sodium Hypochlorite: the system comprises three polyethylene storage tanks, total capacity 11,300 L (2,500 gallons), and two chemical metering pumps, one standby. All equipment is located in the existing screen room. The system was installed several years ago as a temporary replacement for gas chlorination because there were no areas which could be used safely for gas chlorine storage. There is no instrumentation for the system.

   Because of limited access in the screen room caused by adding this tankage, maintenance and operation of screens, intake gates and other systems is hindered.

B. Aluminum Sulphate: the system comprises a reinforced fibreglass storage tank, a small polyethylene "day tank" and one metering pump. All equipment is located in the existing low lift pumping station. Instrumentation consists of an overflow alarm on the day tank.

C. Polyelectrolyte: the system comprises a single shelf mounted metering pump located in the screen room. The polyelectrolyte is delivered in 220 kg (500 lb.) drums which are stored in a corridor of the building presently serving as a high lift pumping station, and are manhandled into the screen room for use. There is no instrumentation for this system.

D. Sodium Chlorite: the system comprises a 200 L (50 gallon) tank with mixer and a single metering pump located in a closed room in the existing high lift pumping station. The sodium chlorite is stored in 50 and 100 kg steel drums. Since the material is potentially explosive, drums are stored in a temporary steel shed outside the pumping station, next to the switchgear building. There is no instrumentation for this system.

E. Hydrofluosilicic Acid: the system comprises three 2200 L (500 gallon) tanks and two metering pumps located in an open space adjacent to filters 1-3. Insufficient local ventilation and leaky tanks have resulted in some corrosion of nearby equipment. There is no instrumentation for this system.

F. Chlorine Gas: the system comprises a chlorine machine, weigh scale, and system for metering chlorine solution located in a small room in the building presently serving as a high lift station. Occasionally chlorine gas cylinders are stored in a corridor of this building when there is insufficient space in the designated room. When needed, 135 kg (300 lb. cylinders - 150 lb. contents) are manhandled into position. There is limited local instrumentation for this system.

In summary, none of the existing systems are adequate in terms of size of storage, ease of operation, instrumentation etc. Because of the make-shift nature of some of the installations, good design practice for safe working conditions beyond the legal minima could not be achieved.

Much of the equipment is old, and the facilities so widely dispersed throughout the plant, that continued secure operations cannot be guaranteed with present staff, which situation can only worsen with time.

The method of adding coagulants to the water is by no means the most efficient since proper dispersion/mixing is critical to their operation. The cost of sodium hypochlorite is substantially higher than chlorine gas.

The construction of a modern chemical building would alleviate the problems noted, and improve system security.

10. Administration Facilities

The building presently serving as the high lift pumping station also provides one washroom for plant staff, lockers for plant staff, small appliances for food preparation, laboratory space, and control and instrumentation equipment all in an area approximately 36 m^2 (400 sq. ft.).

A lunch room, supervisor's office, filing system and additional control/supervisory equipment are housed in a trailer adjacent to this building.

These facilities bear little resemblance to what would be provided in any major modern water treatment plant, and they are considered to be inadequate except for short term use.

The construction of an administration building to properly provide these facilities, particularly a modern laboratory and control room would improve plant operations. A control room will need to be in service by November, 1982 when the plant computer system is to be installed.

WORST CASE ANALYSIS

The following section discusses capacity of the various plant components on a "reasonable worst case" basis:

1. Intakes

Frazil ice blockage of the large intake would result in a maximum capacity in winter of 29,500 m^3/d (6.5 mgd). The proposed back-flush connection would resolve this problem.

2. Screens

Blockage of the large screen by ice, or a failure in the screen washing mechanism would result in a maximum capacity of 68,200 m^3/d (15 mgd). The proposed new inlet works (with provision for a future screen) would resolve this problem.

3. Raw Water Pumping Station

Failure of the power supply system would result in a maximum pumping capacity of 34,100 m^3/d (7.5 mgd) since only one pump is equipped with diesel power. The proposed new standby diesel generator for low lift pumping duty would resolve this problem.

4. Flocculation Tanks

These tanks contain no mechanical equipment and are therefore not subject to failure.

5. Filtration Building No. 1

Failure of the power supply system would result in an inability to operate any washwater pump. Under these conditions the filtration capacity would progressively reduce while filtered water quality worsened. The proposed new standby diesel generator would resolve this problem.

6. Filtration Building No. 2

Failure of the instrument air system (which serves only this building) would result in a complete loss of automatic control of filters 1-7, but the existing air system is secure since a standby compressor is available.

7. High Lift Station

Failure of the power supply system would result in a maximum pumping capacity of 110,000 m^3/day at average pressure since only one pump is equipped with diesel power.

8. Control Systems

Computer failure or loss of power would be worst cases. The dual computer system and back-up battery power resolve this problem.

9. Chemical Systems

A. Sodium Hypochlorite: a major leak or accidental spillage on delivery of this material would result in spilled material entering the raw water well, as well as the likelihood of severe corrosion of the mechanical equipment in the area. The contaminated water could not be treated and the plant would need to be shut down.

B. Aluminum Sulphate: a major leak, accidental spillage on delivery, or physical damage to this tank would result in spilled material entering the raw water well, as well as some corrosion of structural floors and equipment. The contaminated water could not be treated and the plant would need to be shut down. In addition, coagulation could occur within pumps which would have to be taken out of service, and the same problem could occur at valves.

C. Polyelectrolyte: since only small amounts are stored where spillage could enter the water the problems listed in case B above would be unlikely. However, polymerization at the filter beds would occur and could completely plug the filters reducing plant output to zero, until filters could be manually excavated and refurbished.

D. Sodium Chlorite: worst case could be vandalism at the storage area resulting in a substantial explosion and damage to the adjacent switchgear house (power to the plant would be cut).

E. Hydrofluosilicic Acid: worst case could be a major leak or accidental spillage on delivery. These could result in severe contamination of finished water which could be pumped into the distribution system before corrective action could be taken. Under certain conditions the concentration in the water could be high enough to have very serious health effects on consumers.

F. Gas Chlorine: worst case would be leakage from a storage area releasing toxic fumes into the plant or adjacent areas. Gas sensors within the plant would alert operators to this problem. A modern, properly designed chemical building would resolve these problems.

10. Administration Facilities

Failures within these facilities are not deemed serious as there would be no threat to health or continued safe operation of the plant and system, assuming that sufficient manpower was available to monitor all parts of the plant and system to compensate for the loss of central control.

PLANT AVAILABILITY TO MEET REQUIREMENTS

We have attempted to review in this section of the report the production capabilities of the various components of the water purification plant. As indicated in our analysis, it is estimated that the maximum required production rate to the year 1985, assuming the committed development as per Section 2 were included, would be approximately 136,500 m^3/d (30.0 mgd). In order to offset reservoir expansions in the system, it is estimated that the production requirements could reach as high as 180,000 m^3/d (40 mgd) in the year 1985. Based on Table 8 attached, included in this section, all of the major components can meet this rate of production.

The ultimate maximum day requirement is 246,000 m^3/d (54 mgd) which is slightly higher than the flocculation and filter capacity rated at 218,000 m^3/d (48 mgd). Some additions may be required at the water plant when the development is approaching capacity.

It is our opinion, however, that some components of the water plant, specifically the chemical systems, standby power, and administration facilities, are inadequate and far below design standards that would normally be expected of a plant of this size and complexity. Continued increase in production requirements can only result in additional potential problems with respect to security of availability of supply with the existing facilities. Specific problems or failures, in particular relating to the chemical facilities could result in necessary short or long term shutdowns of the treatment facility which would effect not only proposed development but also any existing development within the Burlington service area.

APPENDIX A

REGIONAL MUNICIPALITY OF HALTON

CITY OF BURLINGTON WATER DISTRIBUTION STUDY

PROPOSED DESIGN CRITERIA FOR ANALYSIS

UNIT CONSUMPTION RATES

Unit consumption rates for average day, maximum day, maximum hour, morning and evening, and minimum hour shall be adopted for existing and ultimate conditions. Consumption by zone will then be developed by time for each zone.

DISTRIBUTION SYSTEM REQUIREMENTS

Analysis will be undertaken for each of the following conditions:

Maximum Hour, a.m. flows - when the industrial and commercial consumptions are at their peak

Maximum Hour, p.m. flows - when residential consumption, including lawn watering, is at its peak

Night Flows - When the consumption rate is at its lowest value and the reservoirs located far from the source of supply are being filled

Fire Flows - which could occur at any time and which must be added to the average of the maximum day rate as prescribed by the Insurers' Advisory Board Organization

In general, the water pressure requirements within any distribution will range between 270 kPa (40 psi) and 700 kPa (101.5 psi). In the case of fire flows, it is assumed acceptable to allow pressure to drop to a level of 140 kPa (20.3 psi).

In some cases, it may be necessary to deviate slightly from the above requirements; however, in no situation shall the normal pressures

deviate from the range of 200 kPa (29 psi) and 750 kPa (108.8 psi).

STORAGE REQUIREMENTS

The necessary storage capacity in the reservoirs in the system shall be sized to provide for the following:

1. supplement the water plant output by feedback into the systems during peak periods of demand;
2. supply water for fire fighting purposes, since peak conditions may be experienced during a major fire;
3. supply emergency flow during cases of reduced plant output;
4. assist and maintain separate pressures in the distribution system.

The necessary storage capacity of the reservoirs shall be sized as follows:

a) A quantity sufficient to provide balancing between the maximum day condition for the plant output and the peak hour demands of the system. This portion will be adopted as 20 per cent of the maximum day rate.
b) A quantity required for fire fighting purposes for the worst conditions in each zone. A proposed maximum fire flow condition for both the existing and ultimate shall be attained. It is assumed that only one fire flow condition will be required in an individual zone.
c) An additional storage capacity required for emergency. It is also necessary to recommend that an amount equal to 50 per cent of the total of (a) and (b) above be provided for these emergency purposes.

PUMPING STATION REQUIREMENTS

It is recommended that the following design criteria for pumping stations be adopted for both the water system:

1. That the stations be capable of supplying a firm capacity equal to the maximum day rate for the pressure zone with floating storage.
2. That the stations be designed with standby capacity equal to the average day rate for the zone.
3. That the stations be designed for operation with a single pump unit equal to the average day condition, if possible.

Firm capacity shall be defined as:

a) capacity of a pumping station with the largest unit out of service if the station supplies a pressure zone with floating ground storage;

b) the capacity of the station with the two largest pumps out of service if the pumping station serves a zone that does not have floating ground storage.

APPENDIX B

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Mr. R.W.J. Moore, P. Eng.,
Director of Public Works,
Regional Municipality of Halton,
1151 Bronte Road,
Oakville,
Ontario,
L6J 4Z3.

Attention: Mr. H.H. Cripps, P. Eng.
Manager, Planning & Development

Dear Mr. Moore,

Re: Burlington Water Supply System
Deferral of Capital Expenditures

Further to our meeting of February 20th, regarding capital cost deferrals for the Burlington water system, we are pleased to confirm the figures given verbally at the meeting for works that are part of the distribution system.

Since the preparation of our Water Distribution Study in 1976, the projections for population growth appear to have been reduced substantially, and we are uncertain as to the reliability of the current figures. Moreover, since the geographical distribution of the development is unknown, the development of some of the pressure zones could be significantly different from that analysed in 1976. However, for the purposes of these analyses, we have made assumptions where necessary on a conservative basis.

The analyses, which were undertaken by our Mr. Smith, are based on what we understand to be the most up-to-date planning information supplied to us by your Mr. R. MacMillan on or about December 15th, 1978, with respect to revised populations and land use for the City of Burlington. Enclosed herewith is Table 1 with the pertinent information on population and land use data. Based on this information, we have calculated in Table 2 revised figures for consumption for average day, maximum day, maximum hour a.m., maximum hour p.m., and minimum hour in accordance with the

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the recommended unit rates in our 1976 water distribution report. Based on both sources of information, we have attempted to analyse the effects of additional pumping capacity beyond maximum day at the water purification plant, assuming 50 mgd firm capacity.

Under normal conditions, the maximum day rate would be produced from the plant with balancing, fire flow and emergency storage being supplied from the various reservoirs for zones within the system. Assuming it is possible to supply greater than maximum day from the water plant, a portion of the balancing storage for the various zones can be supplied directly from the water purification plant. The only major limiting factor in this respect is the hydraulic capacity of distribution mains within the system.

We have reviewed possible deferrals of reservoir expansions in three major areas of the system as follows:

1. Waterdown Reservoir

   Since the Kingsway Pumping Station has been expanded to a firm capacity of 5.75 mgd, this pumping station is capable of supplying greater than maximum day for the Zone 1A system. As a result, for an interim period, the Kingsway Pumping Station could supply greater than the maximum day rate, to offset balancing storage requirements which would otherwise be provided in the Waterdown Road Reservoir. On this basis, the reservoir expansion could be deferred until on or about the year 1985. It is our understanding that the sum of $500,000 has been included in the 1980 capital budget for this work.

2. Zone 1 Washburn Reservoir

   In our 1976 water distribution report, it was proposed to construct an addition to the Washburn Reservoir for the Zone 1 system by 1981. We

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understand an allowance of $1 million has been allowed for this work. About one-half of the difference between maximum hour and maximum day for Zone 1 could be supplied directly from the plant, based on using about 8.5 mgd of the excess capacity available. This will permit this reservoir expansion to be deferred for about five to six years.

3. Zone III Headon Reservoir and Feedermains

The possible deferrals in the Zone III system are not entirely clear, due to the uncertainty regarding development of the Headon community. It might well be possible however that the Headon Zone III Reservoir, for which $1.2 million is budgeted for 1982, as well as the connecting watermains, for which $475,000 is budgeted for 1982, could be deferred for up to about 7 to 8 years. To do so, the pumping capacity at the Washburn Pumping Station will need to be increased by 5.0 mgd by adding one additional pump at a cost of about $50,000.

Table 3 summarizes the possible dates of deferral and the present programme. The proposed changes result in an equivalent deferral of $4 million for a period of approximately 5 years.

The major reason that these deferrals can be considered is due to the fact that current population projections have been decreased substantially from those used in our report of 1976. As a result, the rate of growth of water demand and the consequential need for additional water system components, has been slowed considerably. If, however, the rate of growth were to increase significantly beyond that now predicted, it would still be possible to accommodate any such changes by advancing the construction of facilities now being deferred.

Because of the substantial changes in projected population growth since 1976, and the need for a re-appraisal of the capital works programme, we

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would suggest that you consider a review of the water distribution report, taking into consideration the current population and industrial land use projections. We believe that the results of this review will greatly assist the Region in the development of the water system as a whole. Moreover, since it might be necessary to carry out further analytical work in connection with servicing for the Headon community, these activities could probably be co-ordinated. Such a review, we believe, might well reveal other areas in which significant deferrals of capital works could be recommended.

We hope the information provided herein will assist you in your present budget planning and, if you would like us to do so, we would be pleased to expand on any of the areas discussed.

Yours very truly,
SIMCOE ENGINEERING LIMITED

T. Fowle, P. Eng.

TF/mn
Encs.

TABLE 1

CITY OF BURLINGTON

REVISED POPULATION AND LAND USE

YEAR	POPULATION	INDUSTRIAL (hectares)	COMMERCIAL (hectares)	COMMUNITY SERVICES	TOTAL
1977	101,000	1092	255	164	1511 (3731)
1982	120,600	1304	304	195	1803 (4452)
1987	131,495	1421	331	213	1965 (4852)
1992	142,390	1539	359	231	2129 (5257)
1997	153,285	1657	386	248	2291 (5656)
2001	162,000	1751	408	265	2424 (5985)

TABLE 2

CITY OF BURLINGTON

SUMMARY OF CONSUMPTION RATES

YEAR	AVERAGE DAY			MAXIMUM* DAY (mgd)	MAXIMUM* HOUR-A.M. (mgd)	MAXIMUM* HOUR-P.M. (mgd)	MINIMUM* HOUR (mgd)
	DOMESTIC (mgd)	INDUSTRIAL COMMERCIAL (mgd)	TOTAL (mgd)				
1977	5.10	5.69	10.79	24.78	38.56	36.79	8.05
1982	6.39	7.35	13.74	31.42	49.07	46.19	10.12
1987	7.30	8.61	15.91	36.30	56.84	52.91	11.64
1992	8.26	10.00	18.26	41.59	65.28	60.11	13.28
1997	9.20	11.31	20.51	46.65	73.34	57.01	14.86
2001	9.72	11.97	21.69	49.30	77.54	70.79	15.78

*0.50 mgd added for Waterdown

TABLE 3

SUMMARY OF RESERVOIR DEFERRALS

BASED ON REVISED PUMPING METHODS

ITEM	ESTIMATED COST ($)	ORIGINAL DATE	PRESENT DATE
Waterdown Road	500,000	1980	1885
Washburn	1,000,000	1981	1985
*Zone III - Reservoir	1,200,000	1983	1990
*Connecting Watermain	475,000	1982	1990

*Depends to some extent on rate of development in Headon Community.

Equivalent to saving $4,000,000 for 5 years.

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REGIONAL MUNICIPALITY OF HALTON

DISCUSSION OF CAPITAL EXPENDITURE DEFERMENT

AT THE BURLINGTON WATER TREATMENT PLANT

INTRODUCTION

The following discussion is related to the work included in Stage 3 of the original construction programme as proposed in Table 13-3 of the Simcoe Engineering Limited report "Report on Proposed Water Purification Plant Expansion for the City of Burlington", April 1976, as modified to include those additional improvements discussed during the preliminary engineering work for this stage of construction, and as authorized by the Region.

In response to a request by the Region, to reconsider this programme, in the light of current water demand forecasts, we have discussed herein the factors which influence any changes in the programme.

Recommendations are made regarding parts of the programme which can be deferred for a short period of time, based on the assumption that the improvements programme would be implemented over a slightly longer period of time and not interrupted. The facilities for which a deferral has been suggested are vital for a large and modern water purification plant, and our recommendation that these works should be a part of the overall improvements programme is unchanged.

In summary, the scope of work previously considered for this construction stage would have included the following items:-

(i) Waste treatment

(ii) Chemical Facilities

(iii) High-lift pumping station and piping

(iv) Sub-station and standby power

(v) Administration and support facilities

(vi) Site access, landscaping, etc.

(vii) Heating improvements

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DISCUSSION ON DEFERRALS

(i) Waste Treatment

The waste treatment concept originally planned as part of the overall plant improvements, was modified during the design of the first stage, and generally included in the present construction stage. As part of the revised waste treatment scheme, the existing No. 9 Sewage Pumping Station will require hydraulic and mechanical improvements, and potentially some other works. It was decided that these improvements at the sewage pumping station should be deferred to the second major construction contract, i.e. Stage 3, and the approval of the Ministry of the Environment was given for the plant expansions, based on the condition that improvements to the sewage pumping station be made at that stage. The costs associated with the necessary improvements are fairly small, ($10,000) and considering the Ministry conditions on these improvements, it is recommended that this work remain as part of the work for the second major construction stage.

(ii) Chemical Facilities

During discussions last year on the design concept for the chemical building, certain minor changes were introduced, but this proposed facility is still essentially in accordance with our 1976 report.

If the chemical building were deferred, improvements to the on-shore raw water intake piping and the new screen room would be deferred also, since these works are part of the same complex. If the chemical building were deferred, it would be necessary to continue to use the existing chemical storage and feed systems. These systems are presently located in the low-lift pumping station, screen room, and filter gallery of filters 1 through 3, at both the upper and lower levels. While operation of these facilities at present is cumbersome since they are widely dispersed, it would be possible with a certain amount of inconvenience, to continue to operate these systems as they presently

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exist without impairing the quality of the water produced. It should be noted however that the present chlorination system makes use of sodium hypochlorite stored in large tanks located in the existing screen room, and that if any major work on screens were required at the present time, this work could be seriously hampered by the lack of space in the screen house. Additionally, at the time when the sodium hypochlorite system was under discussion, it was noted that the cost of chlorine as hypochlorite solution was considerably in excess of the price for ton cylinders, but that since this was only an interim measure, the price differential was acceptable. It should be noted that the difference in cost between the use of hypochlorite and gas chlorine in ton cylinders would be approximately about $12,000 per year. Based on the assumption that deferment of the chemical building would only be for a two year period, there would be no economic advantage to constructing a temporary building for storage of ton chlorine cylinders.

We would, therefore, recommend that the chemical building, new screen room, and improvements to the raw water piping could be deferred.

(iii) High-Lift Pumping Station and Piping

The present high-lift pumping station, as a result of the hydraulic improvements which were made at the station during the interim works stage of the construction programme, has a firm capacity of about 27.5 mgd. Based on the most recently revised population forecasts available to us, and historical data, the maximum day demand will increase to match this capacity during the summer of 1981. Thereafter, the maximum day demand would exceed the available high-lift pumping capacity. It is apparent, therefore, that it is essential not to delay the construction of a new high-lift pumping station. Also, it would be advisable to insist in the construction contract for the next construction stage, that a firm timetable be established for completion and satisfactory operation of the new high-lift pumping station, if necessary in advance of the final completion date for the overall contract.

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It is, therefore, our recommendation that both the new high-lift pumping station and the 60-inch associated feedermain connection proceed without delay.

(iv) Sub-Station and Stand-by Power

To provide an electrical supply which will be both of adequate capacity and secure, we do not consider that the proposed sub-station improvements can be deferred.

With regard to stand-by power, since the benefit of deferring expenditures in the distribution system, can only be realised when the plant output is guaranteed, it will be necessary to provide stand-by power systems as originally recommended for the high-lift pumping station in our report of November 1978. The generator referred to in that report could be located in the new pumping station.

(v) Administration and Support Facilities

The present administration area and support facilities are acknowledged to be much less than satisfactory, but, on a short term basis they are serviceable. As part of the planned control and instrumentation improvements for the system facilities and the plant, it will be necessary to provide a central control location at the plant. This component of the support facilities cannot be deferred without incurring a further delay in the implementation of the instrumentation programme. The other costs associated with this item relate to removal of mechanical equipment for use in the proposed high-lift pumping station, removal of surplus mechanical equipment and piping, and refurbishing of the interior of the present high-lift pumping station to provide the necessary personnel facilities. As it will be considerably more convenient to remove all unnecessary piping and

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equipment at a single time, it is recommended that the only deferment of expenditures under this item would be those which related to providing administration and support facilities other than a new control room, i.e. the laboratory, lunch room, etc. The value of this work is about $138 000.

(vi) Site Access, Landscaping, Etc.

Since, to a large extent, the improvements in site access are required for large chemical deliveries to be made, if the proposed chemical building is deferred, and the present system of operation continues, it would not be necessary to make major improvements to the site access, other than to provide the limited access road which leads to the proposed high-lift pumping station. It is our recommendation that all of the work originally proposed under this item could be deferred.

(vii) Heating Improvements

This is a relatively minor expenditure to remedy an unsatisfactory situation, and was included in the Stage 2 construction contract.

GENERAL

If the outstanding work is divided into two stages, two construction contracts rather than one will be necessary. Although the general contractor's overhead costs will be higher as a consequence, two smaller contracts will probably introduce a higher level of competition, and the net additional cost probably will not be substantially different. Because construction costs are rising with inflation, in general the work included in the second contract will, however, be more costly by about 12%. Although costs for design should not be different, the consultants administration and supervision of construction costs will be higher.

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When the present construction contract is completed, the plant will have a treatment capacity of approximately 50 mgd. To make the best use of the existing filtration capability, and to defer expenditures in the distribution system wherever possible, it is recommended that the new high-lift station have a pumping capacity not less than 50 mgd. After we have reviewed potential deferrals of facilities in the whole system, it might be possible to recommend the deferral of some of the proposed pumping units. But in any case the firm capacity of the high-lift pumping station equipment, when the next construction phase is completed should not, under any circumstances, be less than 35 mgd.

RECOMMENDATIONS

Based on the foregoing discussions, our recommendations are as follows:

1. Complete the necessary works at the No. 9 Sewage Pumping Station.
2. Defer the construction of new site access roads and landscaping.
3. Defer the construction of a new chemical building, screen room, and alterations to intake pipe.
4. Remove mechanical and electrical equipment located in the existing high-lift pumping station, and provide a new and permanent control room. The balance of works envisaged for this administration area can be deferred.
5. The construction of the high-lift pumping station and 60-inch watermain cannot be deferred, but some cost deferrals might be realised by reducing the amount of mechanical equipment originally proposed to be installed in this station.
6. The total estimated value of the works which could be deferred is $1 200 000, and the estimated value and the work which should proceed without delay is $4 025 000.

On the attached Table we have summarised the suggested revised programme and indicated estimated costs and a construction schedule.

A.J. Bowers, P. Eng.

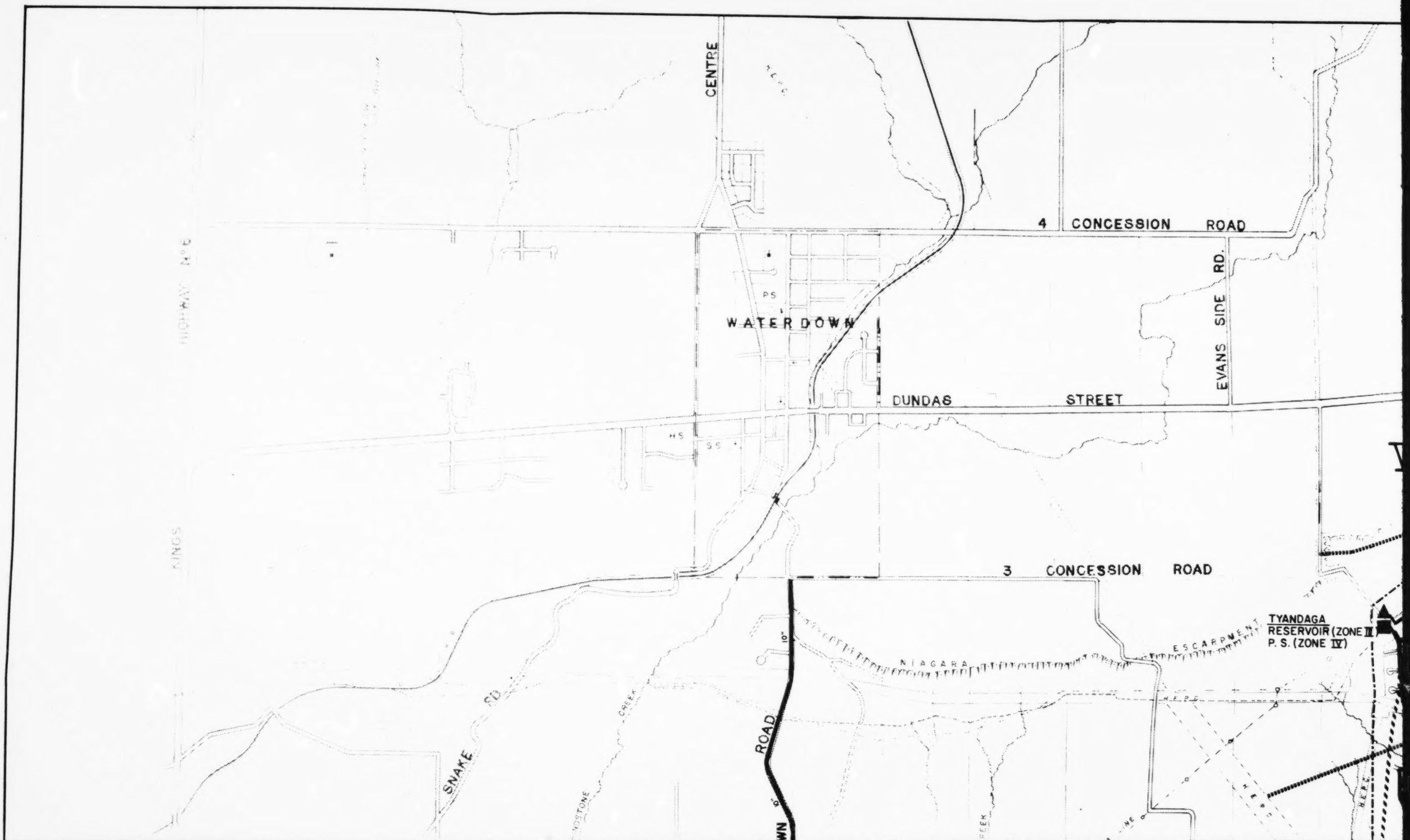
AJB/mn
Att.

ITEM	Stage 3 Total Cost, 1976 dollars as shown in original report ENR = 2269	Stage 3 Total Cost, 1976 dollars as modified by preliminary engineering ENR = 2269	Stage 3 Total Cost 1979 dollars as modified by preliminary engineering ENR = 3130	Stage 3 Total Cost, 1979 dollars. Recommended for Construction	Stage 3 Total Cost, 1979 dollars. Recommended for Deferral
1. Waste treatment	380 000	8 000	10 000	10 000	-
2. Chemical facilities	700 000	700 000	965 000	-	965 000
3. High-lift station & piping	2 500 000	2 450 000	3 380 000	3 380 000	-
4. Sub-station & stand-by power	430 000	410 000	565 000	565 000	-
5. Admin. & Support facilities	150 000	150 000	208 000	70 000	138 000
6. Site Access, Landscaping, etc.	70 000	70 000	97 000	-	97 000
7. Heating Improvements	50 000	-	-	-	-
Estimated Total	$ 4 280 000	3 788 000	5 225 000	4 025 000	1 200 000

SUMMARY : Stage 3 1980-81 $ 4 025 000 Construction & Engineering : High-lift pumping station, trunk watermain, Sub-station & stand-by power, Control room and changes to No. 9 Sewage Pumping Station.

Stage 4 1982-83 $ 1 200 000 Construction & Engineering : Chemical facilities, Administration & Support facilities Site access and Landscaping.

SIMCOE ENGINEERING LIMITED - February 1979


CENTRE
4 CONCESSION ROAD
PS
WATERDOWN
EVANS SIDE RD.
DUNDAS STREET
HS
SS
HIGHWAY
KINGS
SNAKE RD.
3 CONCESSION ROAD
ROAD
10"
NIAGARA ESCARPMENT
TYANDAGA
RESERVOIR (ZONE II)
P. S. (ZONE IV)

ION ROAD

EVANS SIDE RD.

CEDAR SPRINGS ROAD

CUELPH LINE

PROPOSED RESERVOIR
(ZONE III)

WALKERS

BEAUFORT
RESERVOIR (ZONE IV)
& P.S. (ZONE V)

KING

HWY. No 5

V

IV

III

ROAD

BRANT STREET

BLOCK

PROPOSED HWY. 403

BAILIE
RESERVOIR
(ZONE II)
& P.S. (ZONE IV)

HEADON ROAD

TYANDAGA
RESERVOIR (ZONE II)
P. S. (ZONE IV)

ESCARPMENT

TYANDAGA
GOLF COURSE

M.J. ROBINSON

UPPER MIDDL

WASHBURN
RESERVOIR (ZONE I)
P.S. (ZONE II & ZONE III)

BRANT ST.
RESERVOIR
(ZONE I)
& P.S. (ZONE III)

II

PROPOSED RESERVOIR (ZONE III)

PROPOSED RESERVOIR (ZONE II) & P.S. (ZONE III)

CUELPH LINE

WALKERS LINE

HEADON ROAD

ORCHARD ROAD

APPLEBY LINE

UPPER MIDDLE ROAD

No 5

BAILIE RESERVOIR (ZONE II) & P.S. (ZONE IV)

PROPOSED HWY No 403

WASHBURN RESERVOIR (ZONE I) P.S. (ZONE II & ZONE III)

M.J. ROBINSON

IV

III

II

12" (1980-84)

20" (1980-84)

24" (1980-84)

36" (1985-89)

20" (1985-89)

16" (1985-89)

24" (1991-2001)

(PROPOSED) 24"

WATERDOWN ROAD

SNAKE ROAD

OLD YORK ROAD

GRINDSTONE CREEK

BELL TELEPHONE TRUNK LINE

HEPC

2 CONCESSION ROAD

KING ROAD

WATERDOWN RESERVOIR (ZONE IA) & PUMPING STATION (WATERDOWN)

HIGHWAY No. 403

FALCON

12" (AS REQUIRED)

8" 12" (1977-78)

14" (AS REQUIRED)

IA

WEST PLAINS ROAD EAST

SS

PS

KINGSWAY P.S. (ZONE IA)

ALDERSHOT H.S.

LASALLE PARK

BURLINGTON GOLF & COUNTRY CLUB

NORTH SHORE BLVD.

GREENWOOD CEMETERY

HAMILTON HARBOUR

CONCESSION ROAD

KING ROAD

MOUNT FOREST RESERVOIR & P.S. (ZONE II)

BRANT ST. RESERVOIR (ZONE I) & P.S (ZONE III)

WASHBURN RESERVOIR (ZONE I P.S. (ZONE II & ZONE III)

KINGSWAY P.S. (ZONE IA)

SHORE BLVD.

MAINWAY

FAIRVIEW

NEW

H.E.P.C.

C.N.R.

BURLINGTON GOLF & COUNTRY CLUB

GREENWOOD CEMETERY

MOUNTAINSIDE PARK

PARK CENTRAL PARK

HAGER CREEK

TUCK CREEK

ROSELAND CREEK

14" (AS REQUIRED)

TELEPHONE TRUNK LINE

WASHBURN RESERVOIR (ZONE I P.S. (ZONE II & ZONE III)

II

I

APPLEBY

QUEEN ELIZABETH WAY

HARVESTER ROAD

FAIRVIEW STREET

NELSON HIGH SCHOOL

NELSON PARK

CENTRAL PARK

MOUNTAINSIDE PARK

NEW

FIRE HALL

(PROPOSED) 24"

12" (PROPOSED)

MAINWAY 12"

ROSELAND

SHOREACRES

TUCK CREEK

SPUR LINE

P.S.

S.S.

P.C.

WEST PLAINS ROAD

EAST

KINGSWAY P.S. (ZONE 1A)

NORTH SHORE BLVD.

BURLINGTON CANAL

H A M I L T O N H A R B O U R

LEGEND

ZONE BOUNDARY	.....
EXISTING TRUNK FEEDERMAINS	———
EXISTING LOCAL MAINS	———
PROPOSED FEEDERMAINS	— — —
EXISTING PUMPING STATIONS	▲
PROPOSED PUMPING STATIONS	△
EXISTING RESERVOIRS	■
PROPOSED RESERVOIRS	□
WATER TREATMENT PLANT	★
STUDY AREA LIMIT	—·—·—
PARKWAY BELT WEST LIMIT	·—·—·—

KINGSWAY P.S.
(ZONE IA)

SHORE BLVD.

BURLINGTON GOLF & COUNTRY CLUB

GREENWOOD CEMETERY

QUEEN ELIZABETH WAY

HAGER CREEK

C N R

P C CENTRAL P.S.

PARK CENTRAL PARK

ROSELAND CREEK

TUCK

FAIRVIEW

NEW

GENERAL BROCK

SPENCER SMITH

MUSEUM

JOSEPH BRANT MEMORIAL HOS.

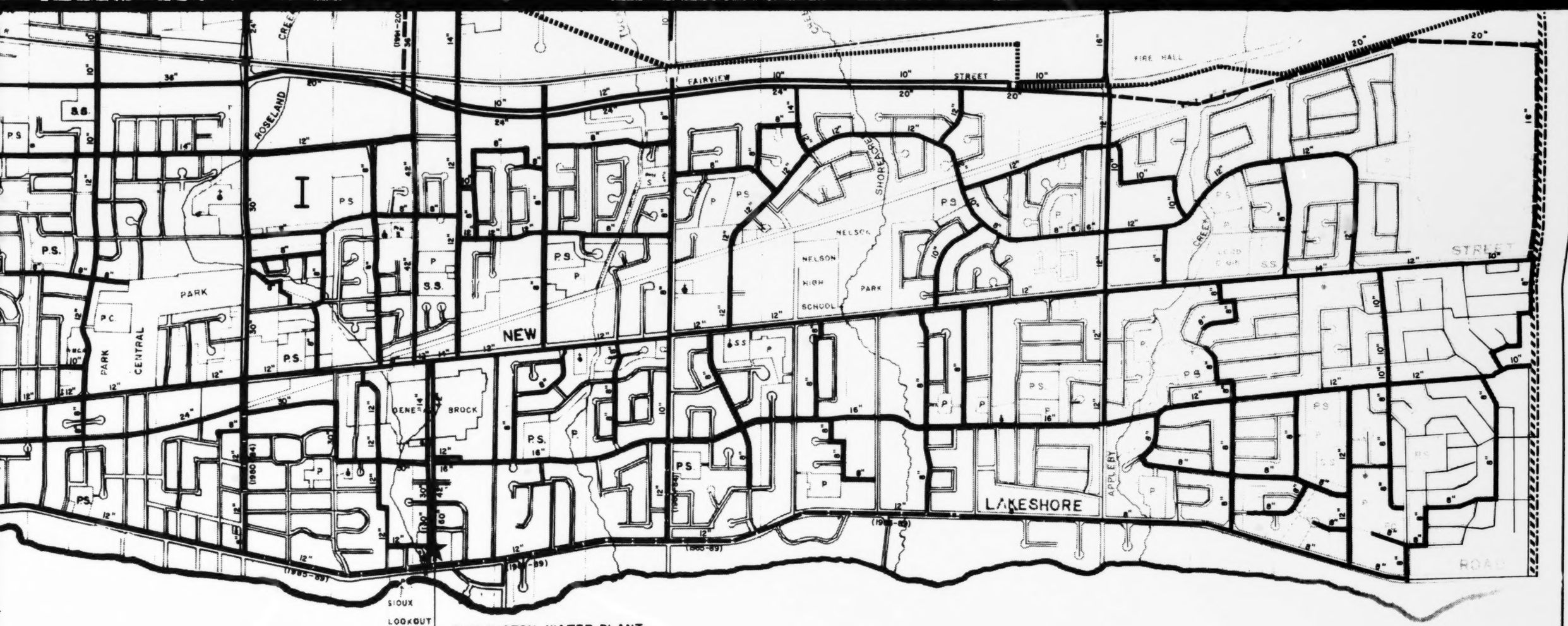
C.C.I.W.

BURLINGTON CANAL

SIOUX LOOKOUT

BURLINGTON WATER PLANT

LAKE ONTARIO



LAKE ONTARIO

REGIONAL MUNICIPALITY OF HALTON

CITY OF BURLINGTON
PROPOSED

WATER DISTRIBUTION SYSTEM IMPROVEMENTS

SIMCOE ENGINEERING LIMITED
CONSULTING ENGINEERS
Scale: 1"= 1325'

Date: JANUARY 1977 (REVISED MAY 1981) DWG NO: 2